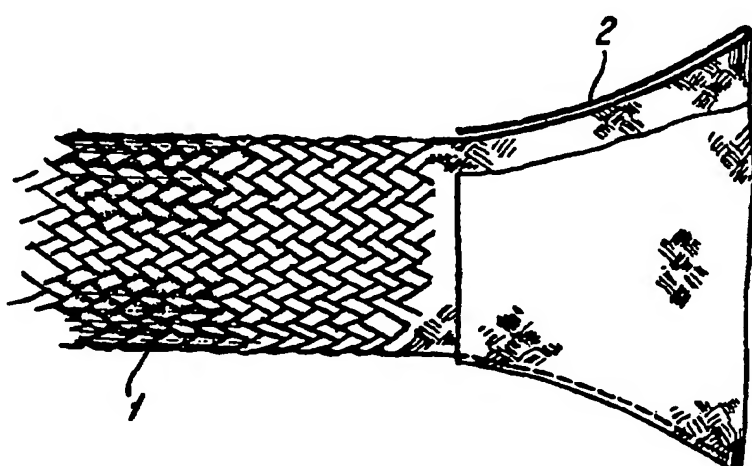




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : F16L 13/10, 9/14	A1	(11) International Publication Number: WO 96/33361 (43) International Publication Date: 24 October 1996 (24.10.96)
<p>(21) International Application Number: PCT/NL96/00169</p> <p>(22) International Filing Date: 18 April 1996 (18.04.96)</p> <p>(30) Priority Data: 1000160 18 April 1995 (18.04.95) NL</p> <p>(71) Applicant (for all designated States except US): NEDERLANDSE ORGANISATIE VOOR TOEGEPAST-NATUURWETENSCHAPPELIJK ONDERZOEK TNO [NL/NL]; Schoemakerstraat 97, NL-2628 VK Delft (NL).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): PEETERS, Johannes, Hendricus, Alphonsus [NL/NL]; Schermblaas 5, NL-3021 KE Rotterdam (NL). VERHEUS, Albert, Simon [NL/NL]; Hendrik Tollensstraat 152, NL-2624 BK Delft (NL).</p> <p>(74) Agent: DE BRUIJN, Leendert, C.; Nederlandsch Octrooibureau, Scheveningseweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report. In English translation (filed in Dutch).</p>
<p>(54) Title: TUBE OF COMPOSITE MATERIAL</p> <p>(57) Abstract</p> <p>A high quality composite tube consists of a plastic-impregnated tubular interweave of threads or fibres, the angle of which with respect to the centre line of the tube is the determining factor for the diameter. At least one end of the interweave is widened and folded over outwards or inwards one or more times. The widened end can serve as the connection element with another tube.</p> 		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

Title: Tube of composite material

The invention relates to a high quality composite tube consisting of a plastic-impregnated tubular interweave of threads or fibres, the angle of which with respect to the centre line of the tube is the determining factor for the diameter.

Composite tubes of this type are used, inter alia, as the drive shaft for helicopters, and are known for their great torsional strength. The connecting flange can form an integral whole with the tube. A drawback of the use of a tubular interweave can be that the ends of the tubes rapidly start to fray.

The aim of the invention is to overcome this drawback and also to make the tube of such construction that the latter is outstandingly suitable for joining by one or both ends to another tube.

According to the invention, the tube mentioned in the preamble is, to this end, characterised in that at least one end of the interweave is widened and folded over outwards or inwards one or more times, the widened end being able to serve as the connection element with another tube.

The connection between one tube and another can be effected by means of the plastic impregnation itself or, after the plastic impregnation has been applied separately, by gluing.

If the tube runs at an angle with respect to another tube, said other tube can be clicked into the saddle-shaped widening of the first tube which fits around it.

The one and the other tube can also be in line with one another.

The invention also relates to a tubular connection piece, the one widened end of which is joined to a first tube which runs at an angle with respect to the connection piece and the other end of which is joined to a second tube which extends in line with the connection piece.

The fibres or threads preferably consist of glass, aramide or carbon and the plastic impregnation preferably consists of epoxy resin or polyester.

The invention will be explained in more detail with reference to the
5 figures.

Figure 1 shows a first embodiment of part of a tube according to the invention.

10 Figure 2 shows a second embodiment of part of the tube according to the invention.

Figure 3 shows a connection construction for two metal or plastic tubes running perpendicular to one another.

15 Figure 4 shows two composite tubes joined to one another.

Figure 5 shows a cross-section through the tubes according to Figure 4.

20 Figure 6 shows a tube according to the invention which is joined to a second tube in line therewith.

Figure 7 shows a bicycle in which use has been made of tubular connection pieces according to the invention.

25 Figure 1 shows part of a tube consisting of a tubular interweave 1 made of threads or fibres of glass, carbon or aramide or another strong plastic, and an impregnation of epoxy resin, polyester or another suitable plastic. For the sake of clarity, only the interweave is shown on the left; both the
30 interweave and the impregnation are shown on the right.

The threads or fibres of the interweave make an angle with respect to the centre line of the tubular interweave and a mathematical relationship exists between this angle and the diameter of the interweave. For each transition
35 it is possible to calculate what the fibre angle will be and how strong the construction is.

The important feature is that the end shown at 2 is widened in a flare and

the interweave is folded over. This folding over is shown as a single fold outwards in Figure 1 and as multiple folds inwards in Figure 2.

Figure 3 shows that a composite tube 6 (indicated by dash-and-dot lines) according to Figure 1 or 2 is fitted around a metal or plastic tube 5, that a composite tube 8 (dash-and-dot lines) is fitted around a metal or plastic tube 7 and that a connection is made between the composite tubes 6 and 8 whereby the vertical composite tube 6 is provided with the abovementioned flared end 2 and the wall of the tubes 7 and 8 is provided with an opening 3. The flared end section of the composite tube 6, which end section is folded over, extends in a saddle shape over the horizontal pipes 7 and 8 at the location of the opening 3.

Figure 4 shows the connection between two composite tubes running perpendicular to one another.

As can be seen from Figure 5, the horizontal pipe has been, as it were, clicked into the widening 2 of the vertical pipe. The connection between the two pipes in this position can be effected by the plastic impregnation which is applied after the two tubular interweaves have been brought into the position according to Figure 3. Another possibility is that the two interweaves are provided with an impregnation beforehand and are glued to one another in the mutual position according to Figure 3.

Figure 6 shows the situation where two pipes are connected in line with one another, the left hand pipe being provided with a widening 2 with fold-over, into which one end of the right hand pipe has been inserted. The overlapping pipe sections are joined to one another by a common impregnation or by gluing.

In the bicycle frame according to Figure 7, use has been made of various connection pieces 4 for joining together frame tubes which, in order to save weight, preferably also consist of plastic-impregnated interweave tubes. The connection pieces 4 have, at one end, the flared widened section 2 which fits in a saddle shape around a tube positioned at an angle with respect to the centre line of said connection pieces and, at the other end, a section which fits over a frame tube running in line with the centre line of the connection pieces.

The most important aspects of the invention are the folded-over end of the interweave tube, as a result of which there is no fraying in a troublesome location, and the flared widening of a folded-over end, by which means a robust, easy to produce connection with another tube can be provided.

Claims

1. High quality composite tube consisting of a plastic-impregnated tubular interweave of threads or fibres, the angle of which with respect to the
5 centre line of the tube is the determining factor for the diameter, characterised in that at least one end of the interweave is widened and folded over outwards or inwards one or more times, the widened end being able to serve as the connection element with another tube.
- 10 2. Tube according to Claim 1 connected to another tube, characterised in that the connection between the one and the other tube is produced by the plastic impregnation.
- 15 3. Tube section according to Claim 1, connected to another tube, characterised in that the connection between the one and the other tube has been produced by gluing.
- 20 4. Tube according to Claim 2 or 3, characterised in that said tube runs at an angle with respect to the other tube and said other tube has been clicked into the saddle-shaped widening of the first tube which fits around it.
5. Tube according to Claim 2 or 3, characterised in that the one tube and the other tube are in line with one another.
- 25 6. Tubular connection piece according to Claim 1, characterised in that the one widened end is joined to a tube which runs at an angle with respect to the tube section and the other end is joined to a second tube which extends in line with the connection piece.
- 30 7. Tube according to one of the preceding claims, characterised in that the fibres or threads consist of glass, aramide or carbon and the plastic impregnation consists of epoxy resin or polyester.
- 35 8. Pipes made of metal or plastic which run at an angle with respect to one another and are connected to one another in that a composite tube consisting of a plastic-impregnated tubular interweave has been fitted around both pipes, one of said composite tubes consisting of the tube according to Claim 1, which is joined by its flared end to the other composite tube.

1/4

fig-1

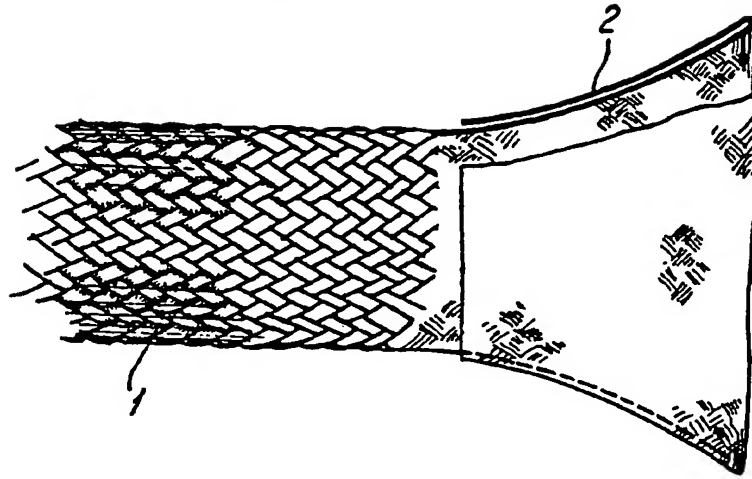
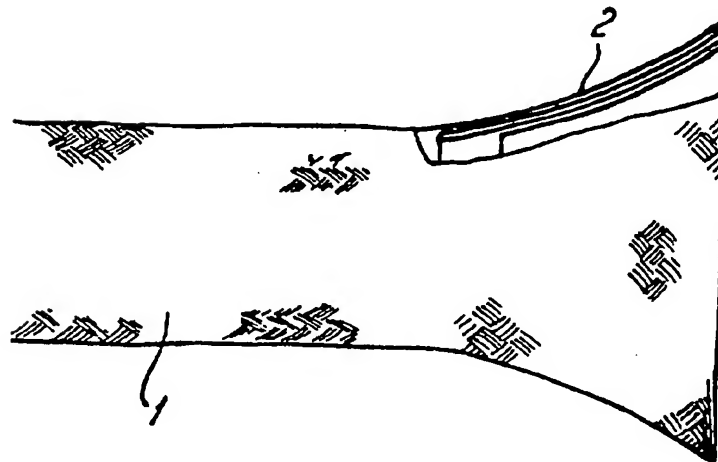
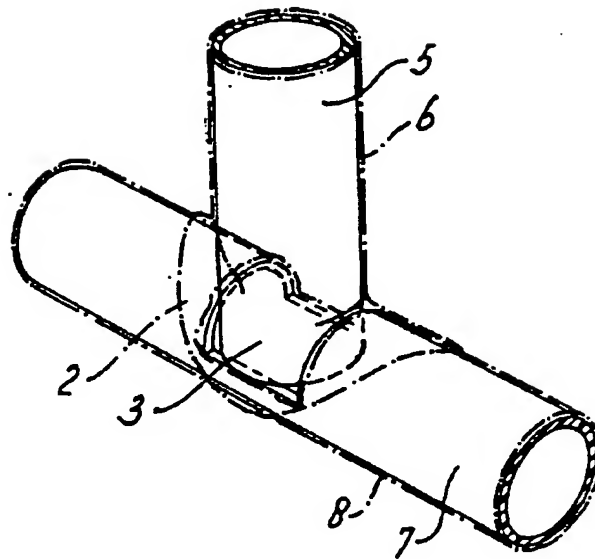


fig-2



2/4

fig-3



3/4

fig-4

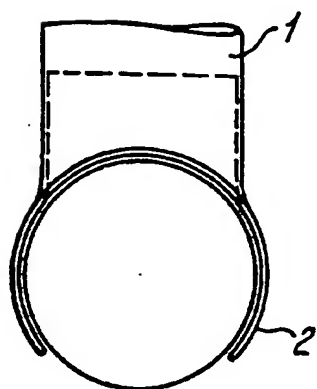
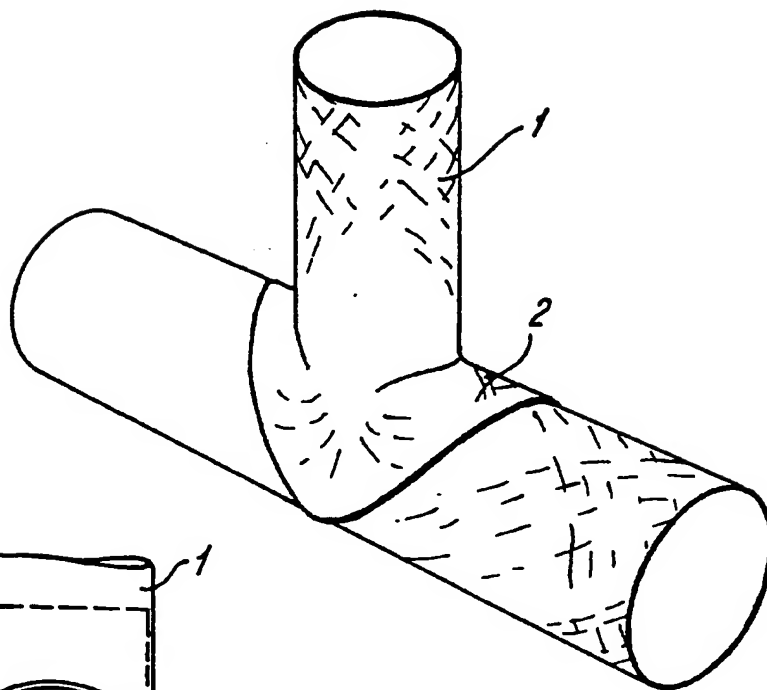
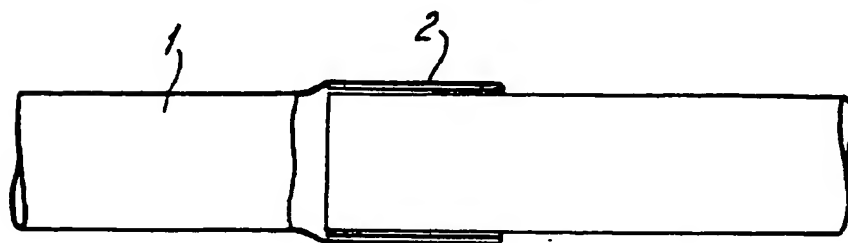


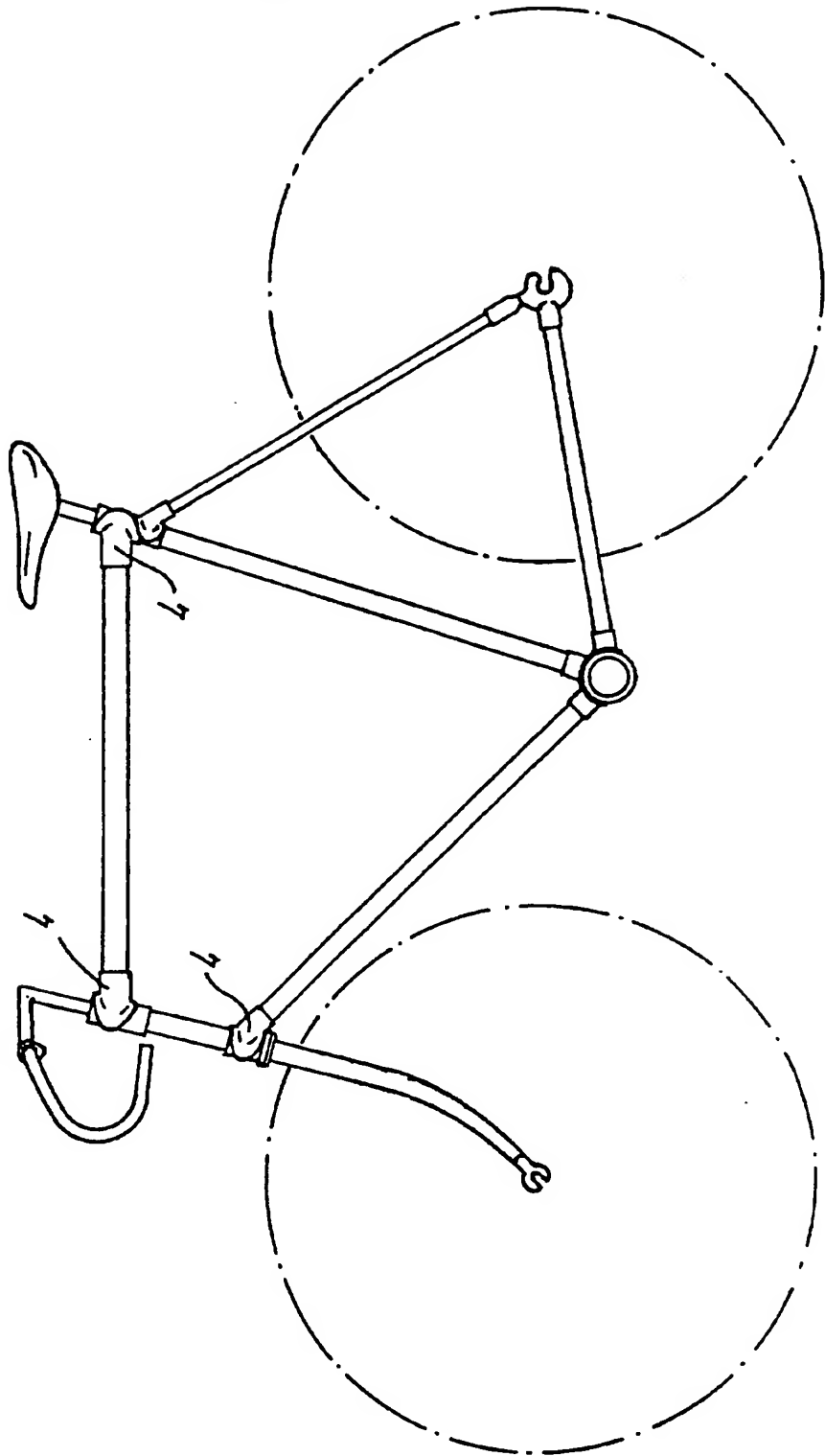
fig-5

fig-6



4/4

fig-7



INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL 96/00169

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L13/10 F16L9/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F16L B62K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB,A,1 335 756 (FIBERGLASS RESOURCES) 31 October 1973 see page 2, line 115 - page 3, line 17; figures 1,2	1,5,7
A	US,A,3 388 932 (BRADLEY) 18 June 1968	
A	GB,A,2 219 057 (SIGRI) 29 November 1989	
A	GB,A,2 219 058 (SIGRI) 29 November 1989	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *A* document member of the same patent family

Date of the actual completion of the international search

28 June 1996

Date of mailing of the international search report

02.07.96

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+ 31-70) 340-3016

Authorized officer

Boutelegier, C

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 96/00169

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-1335756	31-10-73	NONE	
US-A-3388932	18-06-68	NONE	
GB-A-2219057	29-11-89	DE-A- 3818066	07-12-89
		FR-A- 2632046	01-12-89
		US-A- 4941692	17-07-90
GB-A-2219058	29-11-89	DE-A- 3818067	07-12-89
		FR-A- 2632047	01-12-89
		JP-A- 2026394	29-01-90
		US-A- 4921283	01-05-90